

WHAT IS CLAIMED:

1. A method of imparting virus resistance to plants, said method comprising:
silencing a gene encoding a translation initiation factor eIF4E in
5 the plant under conditions effective to impart virus resistance to the plant.
2. The method according to claim 1, wherein said silencing comprises:
providing a transgenic plant or plant seed transformed with a
10 heterologous nucleic acid molecule which silences a gene encoding a translation initiation factor eIF4E in the plant and
growing the transgenic plant or a transgenic plant grown from the transgenic plant seed under conditions effective to impart virus resistance to the transgenic plant.
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3. The method according to claim 2, wherein said nucleic acid molecule is an antisense oligonucleotide complementary to a messenger RNA encoding the translation initiation factor eIF4E.
- 20 4. The method according to claim 2, wherein said nucleic acid molecule is a sense oligonucleotide homologous to a messenger RNA encoding the translation initiation factor eIF4E.
- 25 5. The method according to claim 2, wherein said nucleic acid molecule mediates RNA interference (RNAi) of said gene or of a transcript of said gene.
6. The method according to claim 1, wherein said gene comprises: (i) a nucleotide sequence that is at least 90 percent similar to SEQ ID NO:1; and/or (ii) a nucleotide sequence that hybridizes to SEQ ID NO:1 under
30 stringent hybridization conditions of a hybridization buffer comprising 20 percent formamide in 0.9M saline/0.09M SSC buffer at a temperature of 42°C.

7. The method according to claim 1, wherein said silencing is effective in imparting virus resistance to plants against viruses of the *Potyviridae* family.

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8. The method according to claim 7, wherein said silencing is effective in imparting virus resistance to plants against *Potyviridae* viruses selected from the group consisting of Lettuce Mosaic Virus, Pepper Mottle Virus, Potato Virus Y, Tobacco Etch Virus, and Turnip Mosaic Virus.

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9. The method according to claim 2, wherein the nucleic acid molecule encodes a heterologous translation initiation factor eIF4E which comprises an amino acid sequence of SEQ ID NO:4 and variants thereof that are at least 95 percent similar to SEQ ID NO:4.

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10. The method according to claim 2, wherein the nucleic acid molecule encodes a heterologous translation initiation factor eIF4E which comprises an amino acid sequence of SEQ ID NO:6 and variants thereof that are at least 95 percent similar to SEQ ID NO:6.

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11. The method according to claim 2, wherein the nucleic acid molecule encodes a heterologous translation initiation factor eIF4E which comprises an amino acid sequence of SEQ ID NO:8 and variants thereof that are at least 95 percent similar to SEQ ID NO:8.

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12. The method according to claim 2, wherein the nucleic acid molecule encodes a heterologous translation initiation factor eIF4E which comprises an amino acid sequence that is at least 85 percent similar to a non-mutant translation initiation factor eIF4E of SEQ ID NO:2 and containing at least one substitution of at least one amino acid residue of SEQ ID NO:2 selected from the group consisting of T51A, P66T, V67E, K71R, L79R, G107P, and D109R.

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13. The method according to claim 2, wherein the transgenic plant is selected from the group consisting of rice, wheat, barley, rye, cotton, sunflower, peanut, corn, potato, sweet potato, bean, pea, chicory, lettuce, endive, cabbage, cauliflower, broccoli, turnip, radish, spinach, onion, garlic, eggplant, pepper, celery carrot, squash, pumpkin, zucchini, cucumber, apple, pear, melon, strawberry, grape, raspberry, pineapple, soybean, tobacco tomato, sorghum, sugarcane, banana, mung bean, alfalfa, rye, brussel sprout, beet, parsnip citrus, *Arabidopsis*, *Saintpaulia*, petunia, pelargonium, poinsettia, chrysanthemum, carnation, and zinnia.
14. The method according to claim 2, wherein a transgenic plant is provided.
15. The method according to claim 2, wherein a transgenic plant seed is provided.
16. The method according to claim 2, wherein said providing comprises:
providing a genetic construct comprising the nucleic acid molecule
and
transforming a plant cell with the genetic construct.
17. The method according to claim 16 further comprising:
propagating plants from the transformed plant cell.
18. The method according to claim 16, wherein the genetic construct further comprises:
a plant promoter and
a terminator, wherein the plant promoter and the terminator are
operatively coupled to the nucleic acid molecule.
19. The method according to claim 18, wherein the genetic construct is in an expression vector.

20. The method according to claim 16, wherein said transforming is carried out by *Agrobacterium*-mediated transformation, biolistic transformation, or electroporation.
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21. A genetic construct comprising:
a nucleic acid molecule which silences a gene encoding a translation initiation factor eIF4E in a plant;
a plant promoter heterologous to the nucleic acid molecule; and
10 a terminator, wherein the plant promoter and the terminator are operatively coupled to the nucleic acid molecule.
22. An expression system containing the genetic construct according to claim 21.
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23. The expression system according to claim 22, wherein the nucleic acid molecule is in proper sense orientation.
24. A host cell transformed with the genetic construct
20 according to claim 21.
25. The host cell according to claim 24, wherein the host cell is a plant cell or a bacterial cell.
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26. A plant transformed with the genetic construct according to claim 21.
27. The plant according to claim 26, wherein the plant is selected from the group consisting of rice, wheat, barley, rye, cotton, sunflower,
30 peanut, corn, potato, sweet potato, bean, pea, chicory, lettuce, endive, cabbage, cauliflower, broccoli, turnip, radish, spinach, onion, garlic, eggplant, pepper, celery carrot, squash, pumpkin, zucchini, cucumber, apple, pear, melon, strawberry, grape, raspberry, pineapple, soybean, tobacco tomato, sorghum,

sugarcane, banana, mung bean, alfalfa, rye, brussel sprout, beet, parsnip citrus, *Arabidopsis*, *Saintpaulia*, petunia, pelargonium, poinsettia, chrysanthemum, carnation, and zinnia.

- 5 28. A component part of the plant according to claim 26.
29. A fruit of the plant according to claim 26.
30. A plant seed produced from the plant according to claim 26.
- 10 31. A plant seed transformed with the genetic construct
 according to claim 21.
32. The plant seed according to claim 31, wherein the seed is
15 from a plant selected from the group consisting of rice, wheat, barley, rye, cotton,
 sunflower, peanut, corn, potato, sweet potato, bean, pea, chicory, lettuce, endive,
 cabbage, cauliflower, broccoli, turnip, radish, spinach, onion, garlic, eggplant,
 pepper, celery carrot, squash, pumpkin, zucchini, cucumber, apple, pear, melon,
 strawberry, grape, raspberry, pineapple, soybean, tobacco tomato, sorghum,
20 sugarcane, banana, mung bean, alfalfa, rye, brussel sprout, beet, parsnip citrus,
 Arabidopsis, *Saintpaulia*, petunia, pelargonium, poinsettia, chrysanthemum,
 carnation, and zinnia.
33. An isolated nucleic acid molecule encoding a mutant
25 translation initiation factor eIF4E that is effective in imparting virus resistance in
 plants, wherein said mutant translation initiation factor eIF4E comprises:
- (i) an amino acid sequence of SEQ ID NO:4 and variants
 thereof that are at least 95 percent similar to SEQ ID NO:4;
- (ii) an amino acid sequence of SEQ ID NO:6 and variants
30 thereof that are at least 95 percent similar to SEQ ID NO:6;
- (iii) an amino acid sequence of SEQ ID NO:8 and variants
 thereof that are at least 95 percent similar to SEQ ID NO:8; or

(iv) an amino acid sequence that is at least 85 percent similar to a non-mutant translation initiation factor eIF4E of SEQ ID NO:2 and containing at least one substitution of at least one amino acid residue of SEQ ID NO:2 selected from the group consisting of T51A, P66T, V67E, K71R, L79R, G107P, and
5 D109R.

34. An isolated mutant translation initiation factor eIF4E encoded by the nucleic acid molecule according to claim 33.

10 35. A recombinant expression system comprising the nucleic acid molecule according to claim 33.

36. The recombinant expression system according to claim 35, wherein the nucleic acid molecule is in sense orientation relative to a promoter.
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37. A host cell comprising the nucleic acid molecule according to claim 33.

38. The host cell according to claim 37, wherein the nucleic acid molecule is in an expression system.
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39. The host cell according to claim 37, wherein the host cell is selected from the group consisting of a bacterial cell, a fungal cell, a yeast cell, a plant cell, or an algal cell.
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40. A transgenic plant transformed with the nucleic acid molecule according to claim 33.

41. A transgenic plant seed transformed with the nucleic acid molecule according to claim 33.
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42. A method of making a mutant translation initiation factor eIF4E comprising:

growing a host cell according to claim 37 under conditions whereby the host cell expresses the mutant translation initiation factor eIF4E and
5 isolating the mutant translation initiation factor eIF4E.

43. The method according to claim 42, wherein said growing is carried out *in vitro* in a growth medium.

10 44. A method of making a transgenic plant having enhanced virus resistance compared to that of a non-transgenic plant, said method comprising:

transforming a non-transgenic plant cell with a nucleic acid molecule according to claim 33 under conditions effective to yield a transgenic
15 plant cell having enhanced virus resistance compared to that of a non-transgenic plant and

regenerating a transgenic plant from the transformed plant cell.

45. The method according to claim 44, wherein the transgenic
20 plant is selected from the group consisting of rice, wheat, barley, rye, cotton, sunflower, peanut, corn, potato, sweet potato, bean, pea, chicory, lettuce, endive, cabbage, cauliflower, broccoli, turnip, radish, spinach, onion, garlic, eggplant, pepper, celery carrot, squash, pumpkin, zucchini, cucumber, apple, pear, melon, strawberry, grape, raspberry, pineapple, soybean, tobacco tomato, sorghum,
25 sugarcane, banana, mung bean, alfalfa, rye, brussel sprout, beet, parsnip citrus, *Arabidopsis*, *Saintpaulia*, petunia, pelargonium, poinsettia, chrysanthemum, carnation, and zinnia.

46. The method according to claim 44 further comprising:
30 recovering a transgenic plant seed from the transgenic plant.

47. A transgenic plant seed produced according to the method of claim 46.

48. A transgenic plant produced by growing the transgenic plant seed according to claim 47.

5 49. A transgenic plant produced according to the method of claim 44.

50. A method of imparting virus resistance to plants, said method comprising:

10 providing a nucleic acid molecule encoding a heterologous translation initiation factor eIF4E and
transforming a plant with the nucleic acid molecule under conditions effective to yield a transgenic plant that overexpresses said heterologous translation initiation factor eIF4E, wherein said method is effective
15 in imparting virus resistance to the transgenic plant.

51. The method according to claim 50, wherein said transgenic plant is resistant against viruses of the *Potyviridae* family.

20 52. The method according to claim 51, wherein said transgenic plant is resistant against *Potyviridae* viruses selected from the group consisting of Lettuce Mosaic Virus, Pepper Mottle Virus, Potato Virus Y, Tobacco Etch Virus, and Turnip Mosaic Virus.

25 53. The method according to claim 50, wherein the heterologous translation initiation factor eIF4E comprises:
(i) an amino acid sequence of SEQ ID NO:4 and variants thereof that are at least 95 percent similar to SEQ ID NO:4;
(ii) an amino acid sequence of SEQ ID NO:6 and variants
30 thereof that are at least 95 percent similar to SEQ ID NO:6;
(iii) an amino acid sequence of SEQ ID NO:8 and variants thereof that are at least 95 percent similar to SEQ ID NO:8; or

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- (iv) an amino acid sequence that is at least 85 percent similar to a non-mutant translation initiation factor eIF4E of SEQ ID NO:2 and containing at least one substitution of at least one amino acid residue of SEQ ID NO:2 selected from the group consisting of T51A, P66T, V67E, K71R, L79R, G107P, and
5 D109R.

54. A transgenic plant produced according to the method of claim 50.

- 10 55. The transgenic plant according to claim 54, wherein said transgenic plant is selected from the group consisting of rice, wheat, barley, rye, cotton, sunflower, peanut, corn, potato, sweet potato, bean, pea, chicory, lettuce, endive, cabbage, cauliflower, broccoli, turnip, radish, spinach, onion, garlic, eggplant, pepper, celery carrot, squash, pumpkin, zucchini, cucumber, apple, pear,
15 melon, strawberry, grape, raspberry, pineapple, soybean, tobacco tomato, sorghum, sugarcane, banana, mung bean, alfalfa, rye, brussel sprout, beet, parsnip citrus, *Arabidopsis*, *Saintpaulia*, petunia, pelargonium, poinsettia, chrysanthemum, carnation, and zinnia.

20 56. A component part of the plant according to claim 54.

57. A fruit of the plant according to claim 54.

25 58. A plant seed produced from the plant according to claim 54.